PROCEEDINGS
OF THE
CALIFORNIA ACADEMY OF SCIENCES
FOURTH SERIES

Vol. XXX, No. 19, pp. 401–405; 1 fig. September 30, 1968

THREE LATE CENOZOIC MOLLUSCAN FAUNULES FROM BAJA CALIFORNIA, WITH A NOTE ON DIATOMITE FROM WEST OF SAN FELIPE

By

Leo G. Hertlein

California Academy of Sciences
San Francisco, California 94118

Fossil mollusks of late Cenozoic age have been reported from various localities in Baja California. In the present paper three faunules are reported from fossiliferous strata at localities not heretofore mentioned in the literature. The specimens forming the basis of the lists are in the collections of the Department of Geology of the California Academy of Sciences.

A small collection of Pleistocene age was assembled by the late Walter R. Heyneman from strata exposed along the southwest coast of Baja California between Point Conejo and Arroyo Conejo. This locality is nearly straight west of La Paz on the east coast of the Peninsula.

Locality 38742 (CAS). Strata exposed along the coast between Point Conejo and Arroyo Conejo, about Latitude 24°06′ North, west coast of Baja California, Sur, Mexico, Walter R. Heyneman collector, 1963. Pleistocene.

PELECYPODA

Anadara tuberculosa Sowerby
Ostrea cf. *O. angelica* Rochebrune
Ostrea cf. *O. corteziensis* Hertlein
Ostrea iridescens Gray
Ostrea megodon Hanley
Chlamys (Argopecten) circularis Sowerby

Chlamys (Nodipecten) subnodosa Sowerby
Pecten (Oppenheimopecten) vogdesi Arnold

GASTROPODA

Oliva spicata Röding in Bolten
Polinices cf. *P. reclusianus* Deshayes

CIRRIPEDIA

Balanus (Balanus) species

All except two of the mollusks in this list have been reported living in the subtropical waters along the west coast of Baja California, and all now live in the Gulf of California. The present assemblage may be considered to represent a faunule of late Pleistocene age.

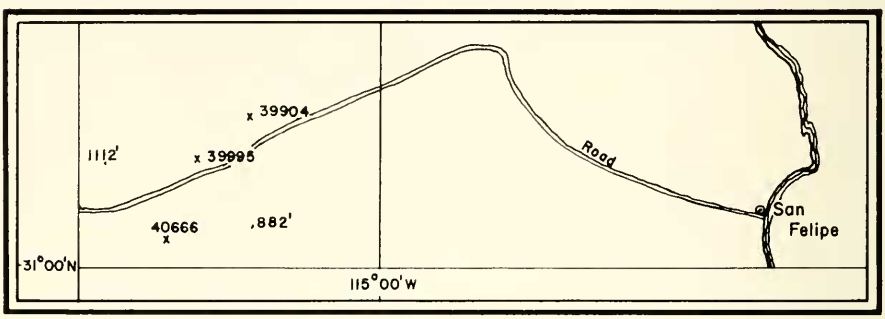

FIGURE 1. Sketch map indicating approximate locations of collecting stations west of San Felipe, Baja California.

Two collections of fossils of Pliocene age were assembled by W. Morlin Childers of El Centro, California. These fossils were collected from strata exposed about 15.5 to 18.5 miles west of San Felipe in the northeastern portion of the peninsula. According to Mr. Childers, the fossil-bearing strata are exposed in a pass where the road to Ensenada crosses and descends to San Felipe Dry Lake. The elevation of the pass is approximately 625 feet above sea level. The hill on the northwest side of the pass is shown on the San Felipe topographic sheet as 1112 feet in elevation, the hill on the southeast side of the pass is 882 feet in elevation. The strike of the strata is Northeast-Southwest except at the Southwest extremity where there are Northwest trending folds. The dip is variable up to 45° Northwest.

Locality 39995 (CAS). About 15.5 miles west of San Felipe, Baja California, along the road to Ensenada, near the northeast end of the fossiliferous outcrop in about Latitude 31°02′00″ North, Longitude 115°05′00″ West. W. Morlin Childers collector, August, 1966. Pliocene.

Locality 40666 (CAS). About three miles southwest of Locality 39995 (CAS), along the strike of the same series of strata toward the southwest end of the

outcrop in approximately Latitude 31°01′00″ North, Longitude 115°06′30″ West. W. Morlin Childers collector, 1967. Pliocene.

LIST OF FOSSILS FROM WEST OF SAN FELIPE.

	39995	40666	Imperial Formation
ECHINOIDEA			
Agassizia scrobiculata Valenciennes	×		
Clypeaster bowersi Weaver (W. M. Childers, written communication)	×		×
Clypeaster cf. *C. carrizoensis* Kew	×		×
Clypeaster deserti Kew	×		×
Encope tenuis Kew	×	×	×
PELECYPODA			
Anadara multicostata Sowerby	cf.	×	
Chlamys (Argopecten) cf. *C. (A.) abietis* E. K. Jordan and Hertlein	×	×	
Chlamys (Chlamys) corteziana Durham	×		×
Ostrea cf. *O. angelica* Rochebrune		×	
Ostrea californica Marcou		×	×
Ostrea heermanni Conrad	×	×	×
Ostrea cf. *O. vespertina* Conrad		×	×
Pecten (Euvola) keepi Arnold		×	×
Pecten (Pecten) cf. *P. (P.) lunaris* Berry		×	
GASTROPODA			
Bulla cf. *B. gouldiana* Pilsbry		×	
Cantharus gemmatus Reeve	×		
Conus species	×		
Cypraea species	×	×	
Fasciolaria princeps Sowerby	×	×	×
Ficus ventricosa Sowerby	×		×
Melongena patula Broderip and Sowerby		×	
Oliva spicata Röding in Bolten	×		×
Polinices species	×	×	
Strombus cf. *S. granulatus* Sowerby	×	×	
Turritella imperialis Hanna		×	×
SHARK TOOTH			
Carcharhinus leucas Valenciennes	×		

This list contains 26 species of which 16 are definitely identified, 7 are compared with known species, and 3 are identified only as to genus. Of these, 12 now live in the Gulf of California and 11 are extinct. Twenty-two have been reported from strata of Pliocene age in the Gulf of California region and 9 of these were originally described from the Imperial formation in Imperial County, California.

A number of species in the present assemblage are characteristic of the Imperial fauna and one may infer that the strata containing them were deposited

approximately contemporaneously with those of the Imperial formation in southeastern California.

Walker (1967, pp. 359, 361) recently reported strata bearing fossils of Pliocene age at three localities: on the west side of the Cocopah Mountains about 20 miles south of the United States-Mexico boundary; in arroyos which cross the coastal plain 35 to 40 miles south of San Felipe; and in the hills west of Gonzaga Bay. Localities 39995 and 40666 (CAS) are thus latitudinally nearly midway between the northernmost and southernmost localities reported by Walker.

DIATOMITE

Locality 39904 (CAS). Diatomite from about 15 miles west of San Felipe, Baja California, approximately in Latitude 31°03′ North and Longitude 115°04′ West, just northeast and adjacent to figure "58" shown on road on San Felipe topographic sheet, Series F501, Sheet NH 11-3, edition 1-AMS. W. Morlin Childers collector, 1967.

A sample of well preserved, soft, white diatomite was collected by W. Morlin Childers from about 15 miles west of San Felipe. This material was examined by Dr. G D. Hanna who furnished the following information.

SPECIES OF DIATOMS FROM LOCALITY 39904 (CAS)

Actinocylus octonarius Ehrenberg
Actinocyclus ralfsii (W. Smith)
Actinoptychus senarius Ehrenberg
Amphora eulensteinii Grunow
Asterolampra flabellata (Greville)
Aulacodiscus margaritaceus Ralfs
Aulacodiscus thumii A. Schmidt
Auliscus sculptus (W. Smith)
Bacteriastrum furcatum Shadboldt
Biddulphia tuomeyii Bailey
Campylodiscus schmidtii Grunow
Clavicula species
Cocconeis dirupta Gregory
Cocconeis sparsipunctata Brun
Corethron species
Coscinodiscus apiculatus Ehrenberg
Coscinodiscus kützingii Schmidt
Coscinodiscus lineatus Ehrenberg
Coscinodiscus nitidus Gregory
Coscinodiscus pacificus Grunow
Coscinodiscus stellaris Roger
Diploneis ornata Schmidt
Eupodiscus californicus Grunow
Grammatophora maxima Grunow
Navicula campylodiscus Grunow
Navicula densistriata Schmidt
Navicula lyra Ehrenberg
Nitzschia princeps Hanna and Grant
Plagiogramma antillarum Cleve
Plagiogramma tessellatum Greville
Stictodiscus californicus Greville
Surirella patens Schmidt
Syndendrium diadema Ehrenberg
Trachyneis aspera (Ehrenberg)
Xanthiopyxis species

The foregoing list contains 32 identified species and three others identified only as to genus. This however is only a small sampling of the flora.

The stratigraphic relations of the diatomite are not personally known to me. Mr. Childers suggested that it may overlie beds containing fossil mollusks of Pliocene age. However, Dr. Edwin C. Allison (written communication to L. G. Hertlein, dated October 25, 1967) stated that the diatomite lies almost hori-

zontally on the axis of an anticline. He further stated, "The San Felipe diatomite lies beneath *Encope tenuis*-bearing strata and probably overlies some sort of volcanic sequence. . . The planktonic foraminifers of the diatomite are middle-upper Miocene (with *Globorotalia acostaensis*). The benthonic foraminifers of the diatomite also appear to be Miocene (Mohnian-Delmontian) though upper range limits of critical species are known only in California where cooling water and other changing conditions, rather than total extinction, may determine range tops."

The assemblage of species of diatoms in the present list is indicative of late Miocene age in comparison with assemblages of that age from southern California or from Rancho Refugio in Baja California del Sur. On the other hand the assemblage is not indicative of Pliocene age in comparison with diatom floras of that age in southern California. A few species such as *Aulacodiscus margaritaceus, Diploneis ornata*, and *Plagiogramma antillarum*, strongly suggest a late Miocene rather than Pliocene age.

ACKNOWLEDGMENTS

The writer here expresses his appreciation of the opportunity to study the collections which became available through the generosity of W. Morlin Childers and the late Walter R. Heyneman. Dr. Edwin C. Allison, Department of Geology, San Diego State College, furnished information concerning the stratigraphic relationship of the fossil-bearing beds west of San Felipe. Dr. G Dallas Hanna, Department of Geology of the California Academy of Sciences, furnished helpful criticism concerning the manuscript and contributed the information concerning the diatomite, and Mrs. Lillian Dempster, Department of Ichthyology in the same institution, furnished information concerning the identification of the shark tooth mentioned in this paper. The line drawing of the sketch map reproduced in figure 1 was prepared by Mr. Hugo H. Hawkins.

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